Vector Management Plan
Ella Bay Development

For

Ella Bay Development Pty Ltd

Prepared By

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1.0 Background

Mosquito Consulting Services Pty Ltd was engaged by the development proponents, Ella Bay Development Pty Ltd, to provide consulting advice on vector (mosquito) and biting midge management measures for their land at Ella Bay. The advice was sought to answer Queensland Health's comments on the Environmental Impact Statement as part of the referral process of the Development Application. In relation to biting flies, Queensland Health's summarised comments were:

> 5.5.4.1 Mosquito breeding sites
>
> The EIS fails to recognise the variety of sites that can be utilised for mosquito breeding within the development site, or the potential impact caused by various species of mosquito dispersing from Ella Bay Wetlands and any nearby salt marsh swamps, particularly within 10km. The Ella Bay Wetland is likely to provide significant numbers of nuisance and disease vector biting insects on a seasonal basis. Other potential natural mosquito breeding sites identified within the development area are the two creek lines and the low lying swampland in the SE portion of the site, particularly in the upper reaches of creeks and reed areas in a flood plain.
>
> 5.5.4.2 Tourist comfort
>
> No mention is made of biting insects (mosquitoes, biting midgies, march flies) that may significantly impact on the comfort and health of residents and tourists.
>
> 5.5.4.3 Storm water drainage systems
>
> Elements of the storm water drainage systems, e.g. infiltration basins, street based swales and/or bio-retention systems (p. 113) will provide potential mosquito breeding sites whenever these structures retain water for a period greater than 7 days. Gross pollutant traps may require regular monitoring and/or maintenance to prevent mosquito breeding.
>
> 5.5.4.4 Mosquito proof housing design
>
> Elements of building design should not facilitate dengue mosquito breeding. Therefore, any subterranean gully traps/drainage pits in new buildings or landscaped areas should be made mosquito proof by making the base of drainage pipe level with the base of the pit e.g. partially fill the pit with concrete (or similar).
>
> 5.5.4.5 Rainwater tanks
>
> Health regulations require that any rainwater tanks be appropriately screened to prevent mosquito exit or entry. Amendments to the Public Health Regulation 2005, to commence on 18/6/07 will specify requirements for the manufacture and maintenance of rainwater tanks to minimise mosquito breeding.

In Queensland Health's covering letter of 21 May 2007 to the Department of Infrastructure reference is made to a need for development of mosquito management plan(s) to ensure best practice outcomes are achieved.

This document is the proposed mosquito management plan for the Ella Bay Development to meet Queensland Health's comments and provide evidence of adequate consideration of the mosquito related risks and their management for the development.

2.0 Design philosophy and limitations of this Vector Management Plan

The design philosophy relative to mosquito and biting midge management is to demonstrate consistency with The Public Health Act 2005 and subordinate legislation; The Environment Protection Act 1994; and Queensland Health's 2002 publication " Guidelines to minimise mosquito and biting midge problems in new developments"; and to optimise the amenity of future development for residents, visitors and tourist. Mosquito related risks will be characterised in terms of likely exposure people may experience within the development. The site is not in close proximity with intertidal estuarine habitat for biting midge of concern. They are not further considered within this management plan.

Mosquito populations fluctuate significantly in their seasonal abundance. When considering this, the report aims to characterise realistic exposure of people to mosquitoes within this general area by interpretation of information from existing sources. Site specific mosquito collections were not conducted for this management plan. From time to time, weather conditions will generally increase mosquito abundance to unusually high levels. At such times increased exposure by residents to biting mosquitoes and mosquito-borne disease in the wider environment will be experienced for limited times.

Controls for mosquito risk management are based in Integrated Pest Management to achieve reduction in risk. This uses a number of interlocking strategies together including passive measures such as locality, physical layout of developments including buffers, stormwater management and appropriate screening to dwellings. Active mosquito control options may include use of insecticides to kill mosquito larvae in breeding sites or adult mosquitoes dispersing to or harbouring in residential areas. The development will be managed in part via a Body Corporate structure. This provides an ability to manage active elements of the control program based on seasonal demand.

2.1 Legislative Controls and Guidelines

Pursuant to the Public Health Act 2005, Queensland Health has the overall responsibility for the control of communicable diseases including mosquito-borne disease including Ross River virus, Barmah Forest virus, Dengue, Japanese Encephalitis and Malaria. Within Schedule 2 of the Act, mosquitoes are listed as Designated Pests. Responsibility for the control of mosquitoes and mosquito-borne disease is selectively divided or shared between Queensland Health and Local Government. Various aspects of the Ella Bay Development come either under State or Local Government responsibility. In addition to mandatory legislative controls other documents taken into account within this management plan include:

- Guidelines to minimise mosquito and biting midge problems in new developments (Qld Health 2002)
- Mosquito Management Code Practice for Queensland (Queensland Government and Local Government Association Inc. 2002)

2.2 Environmental Considerations

The inherent nature of mosquito management activities (whether controlling breeding by larviciding or adulticiding chemicals; or the use of engineering activities), has the potential to adversely affect the receiving environment. Under the Environmental Protection Act 1994 (Queensland Government 2005) clear statements of intentions are made in relation to a person's responsibility and the environment; known as a General Environmental Duty. Under Section 319 the Act defines this duty as:

"*A person must not carry out any activity that causes, or is likely to cause, environmental harm unless the person takes all reasonable and practicable measures to minimise the harm.*"

The Act further details the term Environmental Harm as:

> "*This is any adverse effect, potential adverse effect, (whether temporary or permanent and of whatever magnitude, duration or frequency) on an environmental value…*"

This Mosquito Management Plan is designed to comply with the above instruments and meet generally acceptable expectations of good public health and amenity standards.

3.0 Investigation Methodology

The scope of the investigation included assessment of the site and proposed design relative to relevant legislation and guidelines:

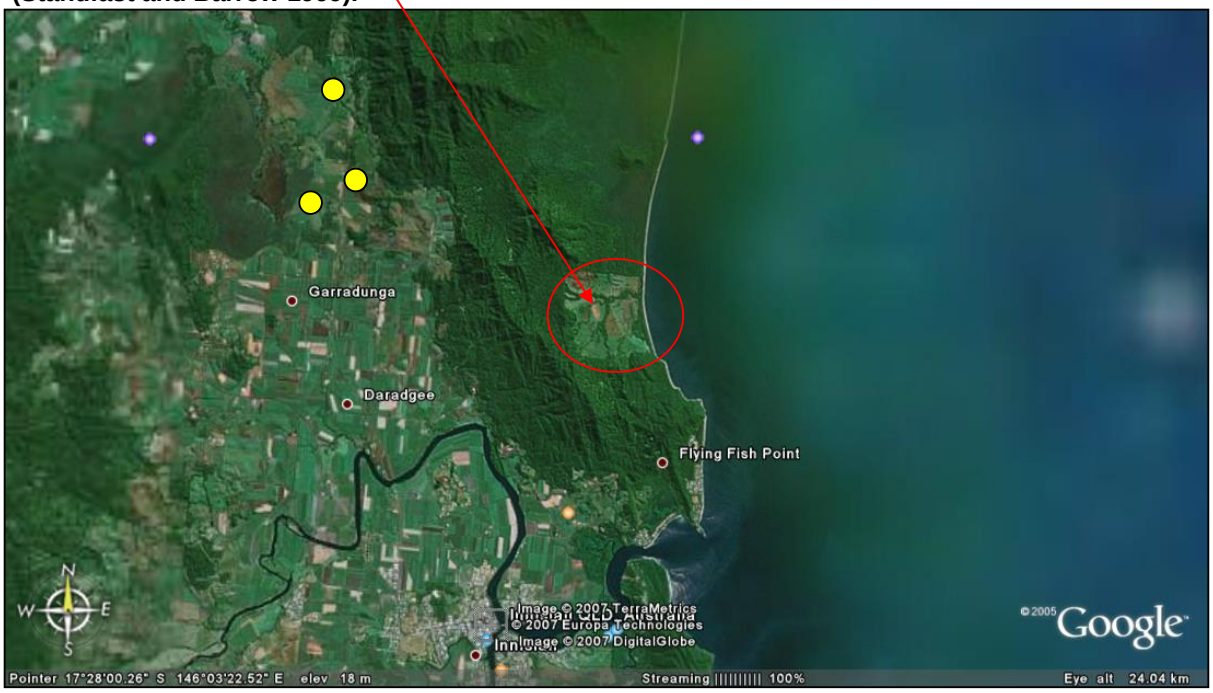
- Search for scientific publications of entomological research and mosquito collections that may be relevant to the development site as a cost effective alternative to undertaking a fresh long-term site specific study.

- Risk assessment with identification of issues to be addressed within the development design and general control measures.

4.0 Proposed Development Site Investigation

The development site is located immediately adjacent to the coast approximately 8 km (by road) north east of Innisfail (Plate 1). Ella Swamp is approximately 1 Km north of the development site and in incorporated into the Ella Bay National Park.

Plate 1: Development Site Locality and Approximate Location of Mosquito Study Sample Sites (Standfast and Barrow 1969).

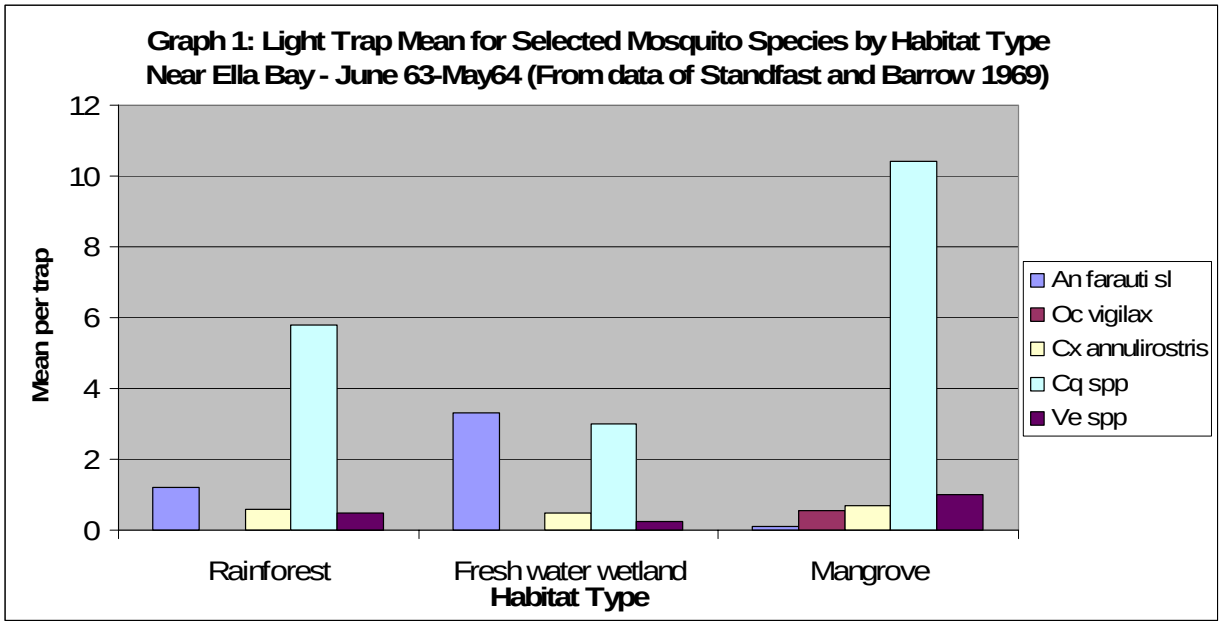


The site location is exposed to coastal weather patterns including a prevailing sea-breeze. According to the Australian Bureau of Meteorology (Commonwealth of Australia 2007), prevailing winds are east to southeasterly with strongest winds (cyclones excluded) usually occurring during April and August. During the summer months, north to northeasterly sea breezes dominate the winds along the coast.

4.1 Previous Studies and Likely Mosquito Risks Relevant to the Development Site.

In Queensland Health's Comments (General) on the EIS, it is stated that informed comment on medical entomology aspects of the proposal is not possible due to the lack of baseline biting insect data from this area. Notwithstanding that no recent mosquito collection data was available for the development site specifically. Past studies conducted by Standfast and Barrow (1969) in the Innisfail area provide very good data collected over 12 months from light traps and animal baited traps of the mosquito fauna of this area. Plate 1 shows the approximate northern most trap locations within a network of trap sites from Innisfail used within that study. Notwithstanding also the time elapsed since Standfast and Barrow (1969) completed their study, the coastal habitat (relative to the development site) remains largely intact and as it was. The data from this study is considered reasonable to provide

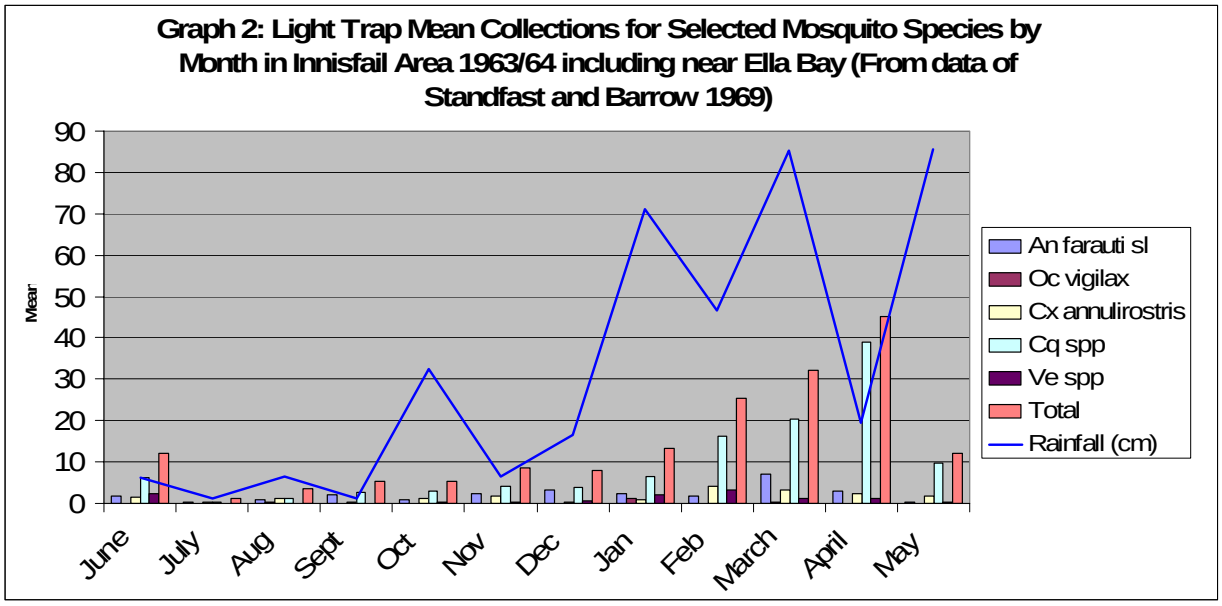
representative mosquito species composition and seasonal abundance very near the development site. This report draws on and re-presents below modified data on the most commonly recorded mosquitoes found by Standfast and Barrow (1969) that are also considered of public health importance in the context of this report. These mosquitoes were *Anopheles farauti sl*, *Culex annulirostris, Aedes vigilax, Coquillettidia* spp and *Verrallina* spp. Three types of habitat included in Standfast and Barrow (1969) were considered also relevant to the development site. These were rainforest, freshwater wetland and mangrove wetland. Graph 1 shows the relative abundance of the target mosquitoes by habitat type at the location marked on the site locality map (Plate 1). Note that the light traps used by Standfast and Barrow (1969) were not baited with any form of chemical attractants and therefore the collections are comparatively small by today's standards of trap technology.



Coquillettidia spp were the most abundant insects collected. Their appearance was most widespread across the different habitat types also. Importantly, *An farauti s.l.* was present in reasonable numbers. This insect is an important vector of malaria and while this disease is not highly prevalent in Australia at present, recent (if limited) outbreaks of this disease north of Cairns makes it relevant to consider for this control program. The salt-marsh breeding *Aedes vigilax* was not present in significant numbers at any time during the 12 month survey. Anecdotal evidence by the study lead author, H.A.Standfast (Pers. Comm. 2007) also indicates this species is not a major risk to this site. *Culex annulirostris* breeds in fresh water grassy pools created by rainfall. As such it is widespread across north Queensland (as with much of Australia) during high rainfall. The development site would not appear to be more significantly exposed to this species than the general region. The Ella Swamp wetland adjoining the development site shows signs of periodic flooding. In a coastal context this habitat provides opportunity for brackish water breeding *Verrallina* species especially *Ve funerea*. This species was present from mangrove collecting sites in Innisfail and from the northern site (Plate 1) also (Standfast and Barrow 1969) and would likely be present in this site adjoining wetlands. *Ve funerea* is recognised as a vector for Ross River virus (Ryan and Kay 1999) and is a nuisance biting insect within its breeding and

harbourage habitat. It does not disperse widely and buffer zones clear of significant harbourage vegetation are relatively effective at reducing their impact within developments.

The seasonal presence of the target mosquitoes coincides strongly with the wet season. Graph 2 shows the monthly collections of the target mosquitoes and monthly rainfall from Standfast and Barrow (1969). This clearly shows increases in all of the target species during the wet season. It is following periods of high rainfall that the greatest mosquito risk will be encountered.



In established urban communities, poor environmental sanitation evidenced by accumulations of discarded articles capable of holding water; poorly maintained garden accouchements and building fittings; and inappropriately stored items may provide breeding opportunity for the Dengue vector, *Aedes aegypti*. The threat from this mosquito generally follows occupation of dwellings and is more a function of occupant's behaviour rather than the intrinsic features of residential developments as such. Recommendations for management of *Ae aegypti* will be made within this document.

5.0 Mosquito Risk Assessment and Management for the Development Site

Mosquito risks for this development were assessed using the Australian and NZ standard for risk management AS/NZS 4360. It gives a framework to consider risk in a disciplined approach that can be repeated in the future to evaluate changes in risk and measure outcomes. The risk management framework follows these basic steps:

- **Identify the Hazard** (Mosquito borne disease, nuisance biting, public complaints)
- **In what Context** (The site's exposure to potential mosquito breeding, the design of the development)
- **Identify the Risks** (As a product of hazard and the likelihood of exposure)
- **Prioritise Risks** (What risks are important,)

- **Control the Important Risks**
- **Evaluate control effectiveness.**

5.1 Hazard characterisation.

The Guidelines to Minimise Mosquito and Biting Midge Problems in New Development Areas (Queensland Health 2002), Mosquito Management Code Practice for Queensland (Queensland Government and Local Government Association Inc. 2002) place emphasis on coastal habitat generally as potential hazard as mosquito production areas. This takes in virtually the whole of the coastal plane including coastal communities. The potential hazards identified and implied by the Guideline include management of mosquito-borne disease and maintaining exposure of people to biting activity to reasonably acceptable levels.

5.2 The context of the proposed development site relative to the hazards

The trapping data from near the site (Standfast and Barrow 1969) and its interpretation indicates that the site shares similar general levels of mosquito exposure to other coastal areas and some site specific mosquito threats. The general threat species include *Ae vigilax* and *Cx annulirostris* as a result of their long flight range, presence of potential habitat within the general region. Published data, anecdotal advice and presence of suitable habitat also support the identification of *Ve funerea* as a potential threat form time to time. Potential *An farauti s.l.* and *Cx annulirostris* habitat also exists including ground water pools potentially retained on site buy more likely on land adjoining. Considering the above, the list of potential threat species in the context of this site includes:

- *An farauti s.l.*
- *Ve funerea*
- *Cx annulirostris*
- *Ae vigilax*
- *Ae aegypti*

The proposed development adjoins natural vegetation that is likely to present harbourage for mosquitoes dispersing from breeding sites outside the site. At present it is not anticipated that an open buffer of any practical dimension will be provided between outer residential allotments and the site boundary. A clear buffer of minimum 10m between the nearest residential allotments and the potential mosquito harbourage around the development margins would be of benefit for management of one of the potential threat species identified - *Ve funerea.* Even relatively narrow buffers are considered to provide a significant barrier to dispersal from potential wetland harbourage into the residential allotments. However, for the wide ranging mosquito species identified as potential threats, *Ae vigilax* and *Cx annulirostris,* buffer zones of less than several hundred meters are generally not effective at preventing their dispersal. In the context of this development, the absence of a buffer would have a relatively small impact on reducing overall mosquito exposure. The seasonal presence of *Cx annulirostris* occurs from time to time over the wider general region somewhat obviates the practical functionality of a buffer in this context. The prevailing sea-breeze should though be considered helpful in minimising intrusion by mosquitoes from the landward harbourage vegetation.

Prevailing sea-breezes during the summer wet season are northerly to north easterly (Commonwealth of Australia 2007). Generally the breeze direction should tend to drive mosquitoes away from the development site. The location of the development east of the wetland is advantageous in this regard. There is little specific data available to suggest that the Ella Bay development would be significantly more exposed to these species than as for the general area.

5.3 Risk assessment

It is considered that the development will be exposed (from time to time) with moderate numbers of mosquitoes dispersing from breeding sites outside the site. The above mentioned threat mosquito species should be controlled by implementing an integrated approach of appropriate build environment design including protection to buildings, water storages (tanks), stormwater systems, outdoor entertainment and recreational focal points and also by implementing an active mosquito control program when required.

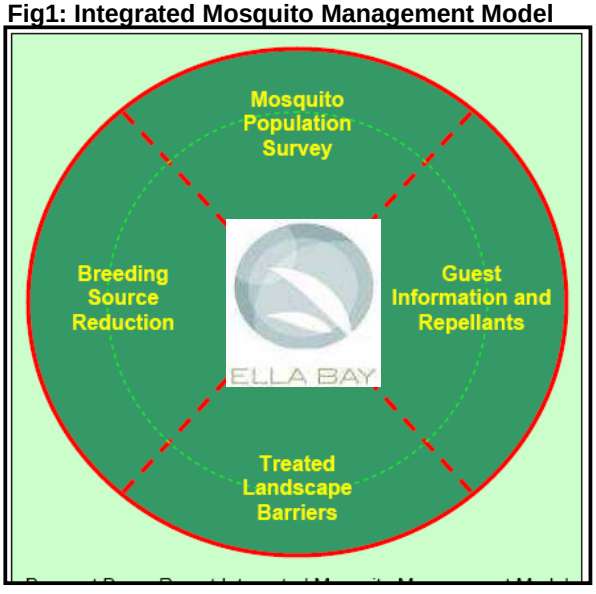
5.4 Risk Assessment Relative to Stormwater Management Systems

- The total area of the proposed stormwater treatment likely to remain wet is very small. In the context of the surrounding area containing freshwater wetlands, the proposed wetlands represent little likely increase in potential habitat.
- Swales feeding the wetlands should flow without standing surface water being available for mosquito breeding.
- The mosquito species of interest most likely to be produced is *Ae aegypti* unless adequate stormwater design is followed per recommendations of this report.
- The potential mosquito impacts from sources outside the development site are considered a higher risk of biting attack with *Ve funerea* the most likely adult mosquito species.

6.0 Recommendations for Mosquito Management:

The Mosquito Management Operational Program is based on Integrated Pest Management (IPM) principles of interlocking strategies aimed at reduction of exposure. Figure 1 is a model of Integrated Mosquito Management for the Ella Bay Development.

Fig1: Integrated Mosquito Management Model



The Mosquito Management Operational Plan for the Ella Bay Development contains the protocols by which mosquito impacts on residents, visitors, tourists and staff will be managed. It provides for an integrated management strategy based on a number of actions designed to minimise exposure to mosquitoes within the development.

Delivery of the operational plan will to be a tri-partisan arrangement between the Body Corporate, a treatment application provider and an independent entomologist. The respective roles and responsibilities of the parties will be detailed within the body of this document. The independent medical entomologist will maintain technical control of the Operational Plan.

The core values upon which the Operational Plan is based are:

- Improving the public health outcomes for residents, visitors and tourists by ensuring compliance with the Public Health Act, Public Health Regulation, the Guidelines to minimise mosquito and biting midge problems in new developments (Qld Health 2002) and the Mosquito Management Code Practice for Queensland (Queensland Government and Local Government Association Inc. 2002)
- Providing for ecological sustainability by compliance the Environmental Protection Act 1994 General Environmental Duty

This plan should be reviewed annually and adjusted according to improvements in our knowledge on mosquito management and ecological sustainability. It is intended as a living document but subject to proper scientific oversight. Changes will be made only to improve outcomes against the listed values.

6.1 Important Limitation

From time to time, prolonged wet weather in the summer mosquito season will produce mass numbers of mosquitoes across the region in general and comprise species outside those normally found within the development site. At such times high mosquito numbers will challenge the efficacy of the Operational Plan. Without compromising the environmental values of the plan, it may not be possible to significantly increase the efficacy of the treatment protocols. During such time, increased reliance on personal protective measures will be required with appropriate information provided to staff and guests.

6.1 Breeding Site Source Reduction

6.1.1 Compliance with Public Health Regulation 2005 Division 2N: Requirement to ensure place is not a breeding ground for mosquitoes

Source reduction is targeted at mosquito breeding sites within the occupied portions of the development. In particular these sites comprise artefacts holding water and providing breeding site for Ae aegypti and ground pools providing breeding opportunity for *Cx annulirostris* and An *farauti* created during construction of the development. These are relatively small in size but are numerous and collectively they represent a significant

breeding opportunity for domestic and peri-domestic mosquito species. In the context of this management plan being the responsibility of the developer during construction, continued control of mosquito breeding within the site will pass to the Body Corporate to ensure good maintenance and environmental sanitation measures are implemented to minimise risk of *Ae aegypti* and ground pool breeding species around dwellings and development infrastructure. There is no intention to reduce ground water pools associated with the rainforest or margins of the development.

6.1.2 Compliance with Public Health Regulation 2005 Div 2P Rainwater Tanks

Control of mosquito breeding in rainwater tanks will be by compliance with the Public Health Regulation 2005 Div 2P and specifically include:

(a) mosquito-proof screens that—
- (i) are made of brass, copper, aluminium or stainless steel gauze; and
- (ii) have a mesh size of not more than 1mm; and
- (iii) are installed in a way that does not cause or accelerate corrosion; and
- (iv) stop mosquitos passing through the openings; or

(b) flap valves that, when closed, stop mosquitoes passing through the openings.

6.1.3 General Stormwater Management

Generically, techniques for the management of urban stormwater to meet required standards of runoff water quality generally include:

- Grass swale drains and buffer strips along road verges and through drainage easements
- Detention ponds to capture allotment runoff for attenuation
- Wetland filters prior to final discharge for storm-water polishing
- Porous pavements, rainwater tanks, infiltration devices, and gross pollutant traps

From a mosquito management perspective, stormwater management systems such as constructed wetlands generally follow design goals that tend to increase opportunities for mosquitoes to breed. If not managed effectively, such wetlands can become a source for unacceptable mosquito production. The basic generic design features that reduce opportunities for mosquitoes in constructed wetlands, in general, include:

- The batter around the constructed wetlands should be as steep as practical (within the design standards for public safety) to minimise shallow water suited to mosquito breeding. If fencing is not used for public safety, a batter not greater than 1:6 is recommended.
- Normal water levels within the wetland should maintain at a minimum of 500mm water depth except for the margins.
- Improve opportunities for wind action to keep the water surface disturbed to reduce availability to mosquito larvae (require contact with stable surface film for respiration). Therefore basin margins should not be planted with shrubs or trees.
- Aquatic macrophytes should not be planted in more than 60% of shallow water (<500mm) around the margin. They should be clumped with separations of open water allowing wind disturbance on the water surface.

- Detention basins and swales should be designed to empty of surface water in less than 7 days to prevent the completion of mosquito breeding cycles.
- Stormwater traps and sumps should be free draining without holding water. The base of pre-cast/moulded stormwater sumps designed to trap sediment should be concrete filled to the invert level of the drainpipe.

6.2 Mosquito Population Survey

Active components of the Mosquito Management Operational Plan including advice to guests and treated barriers will be activated in a timely fashion by monitoring for changes in mosquito populations on the site. A number of parameters will be monitored including:

- Seasonality relative to mosquitoes (generally Oct – May)
- Site rainfall likely to result in increased mosquito breeding.
- Regional weather (rain and winds) likely to influence the regional abundance and dispersal of mosquitoes.
- Mosquito breeding in ground pools.
- Adult mosquito collected in light traps at standard locations within the development.

It is intended that each of the tasks involved in mosquito population monitoring would be progressively activated. Where indications are positive for increasing mosquito production such as high rainfall in summer, then site surveys will be undertaken to determine the status of mosquito populations. Detection of increasing mosquito production would then trigger active components of the program. Advisory information will be provided to The Developer and Body Corporate to begin advice to staff and guests that mosquitoes may become more noticeable and appropriate precautions should be taken.

Progressing from the advisory role, mosquito population changes may then trigger activation of the treated barrier component of the program. The decision to activate this control should not be based on an arbitrary number of mosquitoes collected in light traps. Seasonality, weather forecasts, mosquito species composition, their abundance and human activity will all influence the likely exposure of residents, visitors, tourists and staff to mosquitoes at any given time. The decision to activate barrier treatments will be made consultatively between the independent entomologist and Body Corporate. The objective data including trap results and weather information will be documented and maintained as evidence for decisions made.

6.3 Treated barriers

The occupied buildings of the development are landscaped with high density planted vegetation. The vegetation provides aesthetic softening to the buildings and blends the natural vegetation with the built environment of the development. The planted landscaping however does not function ecologically in the same way as the adjacent natural rainforest community. It would not generally support obligate rainforest dwelling invertebrate fauna species. However, dispersing mosquitoes will use landscape gardens to harbour from hot, dry and windy conditions.

Dispersing mosquitoes from breeding sites and natural vegetation harbourage will generally pass through planted landscape vegetation in order to expose occupants to biting. Selected

partial linea margins of planted landscape vegetation around occupied buildings will undergo treatment with the registered residual insecticide – Bistar Environmental Health Insecticide according to the protocol contained within this operational plan and when indicated by the increasing mosquito activity. The protocol is designed to provide effective treatment of selected landscape features only and not allow insecticide application to interfere with the environment.

Traditionally, many insecticides have been used for controlling adult mosquitoes. Many pesticide products are currently registered for mosquito control. Most are designed to be dispersed over large areas in fine mist-like droplets or fog drifting on the breeze to knock-down flying mosquitoes. The effect of this type of application is destructive to non-target insect species over a relatively wide area. There is limited control over where the insecticide is carried and no way to contain its effect within a defined area. This program is based on an entirely different method using a residual insecticide placed strategically and precisely on artificial surfaces (including selected planted landscape plants) used by dispersing mosquitoes as harbourage within habitable areas.

Bistar Environmental Health Insecticide has been registered for this use by the Australian Pesticide and Veterinarian Medicines Authority (a Federal Government Authority). The use of registered pesticides is prescribed via their approved directions for use. As part of the approval process, pesticides and their directions for use are evaluated by Environment Australia (within the Federal Department of Environment and Heritage). Environment Australia is the agency responsible for the enforcement of the (Federal) Environment Protection and Biodiversity Conservation Act 1999. The use of Bistar Environmental Health Insecticide for treatment of selected landscape features within the Ella Bay Development is consistent with the objectives of environmental sustainability. The approved label for use of Bistar Environmental Health Insecticide and the Material Safety Data Sheet are attached in Appendix 1 of this operational plan.

6.3.1 Method of treatment to selected landscape vegetation.

Treatments will be for a narrow band of landscape vegetation around the perimeter of dwellings as required and public spaces, facilities and focal meeting places. Treatments will be to landscaping vegetation including shrubs and garden plantings in planter boxes and defined garden beds as indicated within the protocol site map. Lawn will not be treated (due to regular clipping reducing active treatment). The vegetated wildlife corridors will not be treated. No product will be allowed to enter waterways and no product will be used on natural rainforest vegetation.

Treatments will be applied with a back-pack type blower sprayer only. High pressure hydraulic sprayers will not be used (due to generation of fine droplets causing drift and poorer coverage of vegetation). The blower sprayer will be operated at low speed to produce droplets > 200 µ and operated in a way that prevents drift occurring.

Plate 2: Typical Backpack type blower sprayer for Bistar Environmental Health Insecticide application to landscape features (The Byron at Byron Resort- Byron Bay NSW)

Applications will not be made if rain is expected within 3 hours of application. The treatment requires drying time before it is rain-fast. Treatments should be repeated no less than 6 weeks apart.

Great care will be taken to prevent any material entering stormwater systems or otherwise entering waterways. Bistar Environmental Health Insecticide is a synthetic pyrethrin. All such pesticides are toxic to aquatic animals. The use permitted on the approved label and protocol within this management plan is designed to prevent it entering into aquatic habitat.

Treatments are required to be made by appropriately qualified and licensed Pest Management Technician. They will be responsible for making treatment reports and maintaining records of treatments. In addition to their statutory responsibilities, all Pest Management Operators engaged in this work will undergo site induction and specific application instruction by the Independent Medical Entomologist.

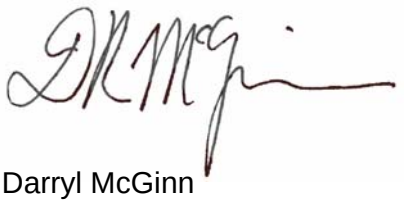
6.4 Detailed Operational Plan.

A detailed operational plan that includes the before mentioned mosquito management processes will be developed for Ella Bay. It will included more detailed mapping of mosquito breeding sites for monitoring (larvae and adults) and specific locations of treated barriers. All rainwater tanks will be identified for regular inspection to ensure continued compliance with Regulations.

7.0 Conclusions

The site will be subject to general regional impact by mosquito activity when seasonal conditions are very wet. This will include periodic exposure by disease vector mosquitoes, *Cx annulirostris*, *Ae vigilax, An farauti, Ve funerea*, *Coquillettidia* species and *Ae aegypti* breeding in habitat across the region and also within the development site . Nearby wetland may contribute an increase in exposure to *Ve funerea* over its general abundance, however if recommendations regarding inclusion of the mosquito management program are implemented the risk from these mosquitoes is considered relatively small. Control of water storage and stormwater treatment on site requires careful implementation to minimise mosquito production and recommendations for achieving this appear in this report. The prevailing breeze during the summer wet season is generally north to north easterly. This is beneficial for further minimising likely incursion of these mosquitoes from breeding sites into the development.

In the context of the proposed Ella Bay development and the recommendations of this mosquito management plan the risk of vector impacts on residents should be managed to within reasonable expectations of public health and amenity.



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